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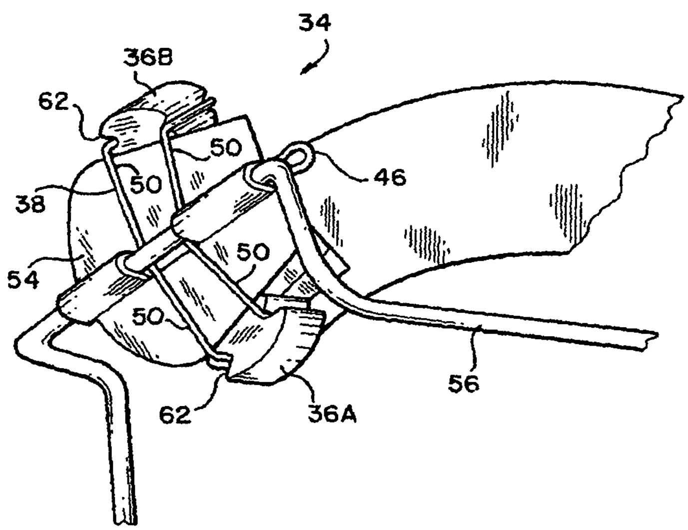
(54) Title: DAMPING SYSTEM FOR MECHANICAL SHUTTER



(57) Abstract: A damping system for an electromagnetically operable shutter (10) includes a detent (40) for arresting the motion of a pivotally supported shutter actuating drive arm (24). The detent (40) has damper portions (68A and 68B) that are fixed to the pivotally supported drive arm (24) and bumper portions (36) that are fixed to positions to receive the impact of the dampers as the arm is pivoted in one direction or another to operate the shutter. The damper portions (68A and 68B) each have a straight edge (70) and the surface of each bumper portion (36) is curved so as to maintain substantially a point contact between the two throughout the duration of the impact. In addition the damper portions are formed of damped polyurethane and each bumper portion is formed of an ultra high molecular weight polyethylene, the combination of materials providing energy absorption while avoiding the adherence of damper and bumper portions upon impact.

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DAMPING SYSTEM FOR MECHANICAL SHUTTER

TECHNICAL FIELD

The present invention relates generally to dampers for lightweight mechanical assemblies and more particularly to a damper for a mechanical shutter such as a photographic shutter.

BACKGROUND ART

Mechanical assemblies having moving parts frequently require damping to protect the parts from damaging impacts and to increase the life and reliability of the assemblies. This is particularly true where the mechanical assembly is lightweight and the impact is repetitive and at a high rate of speed. Electrically operated lens shutters used in various types of photographic and laboratory equipment meet these criteria. For example, a shutter can open and close in a fraction of a second. Electronically operated shutters can operate at frequencies of 2 to 400 cycles per second and higher.

Lens shutters generally are of two types. In one type, a so called "guillotine" shutter has one or two thin, metal blades or leaves arranged to cover a lens opening. Pivot connections allow each blade to swing between a closed position where the blades cover the lens opening and an open position where the blades are drawn aside from the lens opening.

In a second type, a plurality of pivotally mounted blades, usually five, are arranged around the lens. Each blade is connected to a rotatable ring. In the operation of these rotary shutters, the rotation of the ring in one direction causes the blades to swing in unison to an open position. Counter rotation of the ring swings the blades to a closed position over the lens opening after exposure.

It is common in the first type of shutter to provide a shock absorber or damper that absorbs the impact as the blades are pivoted between the open and closed positions. In this respect, reference is made to US Patent No. 3, 595, 553 and No. 3, 664, 251, the disclosures of which are incorporated herein by reference. As disclosed in these references, the shock absorber operates to stop the shutter blade very rapidly, yet softly without damage and with little or no bounce. To Applicant's knowledge, a comparable shock absorbing system has not been used in connection with the rotating ring type of shutters.

One material known to have damping characteristics suitable for use in the damping system of photographic shutters is an ISOLOSS® high density molded product made by Aearo Company. The ISOLOSS® products are high density damped polyurethane thermoset polymers. Sheets and molded parts of this material have been used in a variety of applications relating to noise, shock and vibration reduction. The material has favorable hysteretic damping properties, good compliance and is able to absorb and store mechanical energy while effectively dissipating it in the form of heat.

Dampers made from this polyurethane molded material have been used for some time in combination with other materials such as metals and Teflon coated metal and have provided good results in some applications. However, one disadvantage of the polyurethane molded shock absorbing formulations is that they have a rubbery characteristic and tend to stick to the surfaces that they impact while performing the damping function. In an attempt to remedy this, the impact surface often is coated with Teflon. A Teflon coated surface can reduce or eliminate the sticking when contacting the polyurethane molded damper, however, the Teflon coated surface introduces other problems. Teflon tends to scale and form a powdery residue somewhat like talcum powder in its consistency. In many applications the residue is not harmful but, in some applications, such as optical shutters, the residue may find its way to the surfaces of optical components such as lenses. This powder on the surface of the lens is detrimental to the operation of the lens.

Accordingly, it is an object of the present invention to provide an improved damping system for photographic shutters and in particular, high speed rotary shutters.

Another object of the present invention is to provide a damping system employing a polyurethane molded damper that eliminates sticking of the damper to the impact surface.

A further object is to provide a damping system having an increased operational life.

DISCLOSURE OF INVENTION

In the present invention a rotary shutter is provided with a damping system wherein the swinging motion of the shutter drive arm through an arcuate path of travel is arrested by a detent positioned to engage a member carried by the drive arm. The member is a beam that is generally triangular in cross section. Fixed to each side of the beam is a damper formed of a highly damped polyurethane thermoset material. Impact of the dampers against the detent arrests the movement of the drive arm.

The impact surface of the detents comprises a bumper composed of an ultra high molecular weight polyethylene. This material, together with the shape and disposition of the bumper and damper provide a limited contact area. Having a limited contact area concentrates the impact energy and improves the efficiency of the damping system. When the damper is struck, the material at the point of impact undergoes a transformation from a glass phase to a rubber phase and it is the rubber phase that tends to stick to the impact surface. By limiting the area of contact to a line or more preferably a point contact, the potential "sticky" area is reduced to a minimum.

Accordingly, by careful selection of the shape, materials and arrangement of the damper and bumper, sticking is virtually eliminated. Life testing demonstrates that the components have a much greater life than heretofore achieved with other components. Damping characteristics of the combination are close to ideal for electromechanical shutters and likely for other applications in that the design essentially eliminates bounce or rebound after impact.

Accordingly, the present invention may be characterized in one aspect thereof by a damping system for arresting motion of a small mass such as a photographic shutter or the like driven by a drive arm mounted for swinging motion through an arcuate path of travel. The damping system includes a detent having opposite ends arranged to arrest motion of the arm at each end of the path of travel. In this respect the opposite ends of the detent carry bumpers formed of a high molecular weight polyethylene that are disposed to impact a damper on the drive arm, the damper being composed of a high density polyurethane thermoset material. Both the bumper and damper are shaped to

provide substantially point contact during the duration of the engagement between the damper and the bumper.

BRIEF DESCRIPTION OF DRAWINGS

Figure 1 is a front elevation view of a shutter incorporating the damping system of the present invention;

Figure 2 is a perspective view on an enlarged scale of a portion of Figure 1;

Figure 3 is a plan view of the structure shown in Figure 2 with portions removed for clarity;

Figure 4 is a view taken generally along lines 4-4 of Figure 3;

Figure 5 is a view on an enlarged scale of a portion of Figure 4 showing the disposition of components with the shutter in a closed position; and

Figure 6 is a view on an enlarged scale of a portion of Figure 3.

BEST MODE(S) FOR CARRYING OUT THE INVENTION

Referring to the drawings, Figure 1 shows a rotary shutter generally indicated at 10 incorporating the damping system of the present invention. It should be appreciated that various components, brackets and wiring harnesses of the shutter assemble have been omitted for clarity. For purposes of orientation, the shutter includes a base plate 12 having a central aperture 14. Supported at the underside (not shown) of the base plate are a plurality of shutter blades 16, portions of which are seen through the aperture. The rotary shutter is conventional. It is sufficient for purposes of the present invention to say that the shutter blades are operatively attached to a driver plate (not shown) that rotates with respect of the base plate. Rotation of the driver plate in one direction moves the shutter blades aside and opens the aperture. Reciprocal rotation of the driver plate moves the shutter blades back to the position shown in Figure 1 wherein the aperture is closed.

The means for operating the driver plate includes an electromagnetic actuator 18 mounted to the base plate. The actuator includes an armature 20 that engages a laterally extending rocker arm 22. The rocker arm engages a drive arm 24. The drive arm is flat and formed of very thin sheet metal to minimize mass and is pivotally supported so its

end 26 moves in an arcuate path of travel. At its end 26, the drive arm is connected to a link 28. The link has a connector 30 that extends through an elongated opening 32 in the base plate for connection to the driver plate.

The swinging movement of the drive arm 24 is damped by the damping system of the present invention generally indicated at 34. As best seen in Figure 2 and 3 the damping system includes a pair of bumpers 36 attached to a shaped spring wire 38. One of the bumpers is an inner bumper 36A and the outer is an outer bumper 36B.

The spring wire that supports the bumpers preferably is formed of piano wire about 0.020 inches in diameter and is shaped to form a torsion spring. In this respect the spring wire is formed with a central spine 40 that is bifurcated (Figure 3). The two portions 42, 44 of the bifurcated spine 40 are joined at one end 46 and are spaced apart and unjoined at an opposite end 48. Each of the two portions 42, 44 in turn is bent to form opposed, generally U-shaped arms 50 extending outward from the central spine 40. As best seen in Figures 4 and 5, the opposite ends 52 of the U-shaped arms are each bent downward from the plane of the central spine 40 and support the bumpers below the plane of the central spine 40.

As formed, the arms 50 of the spring wire are bent downwardly from the plane of the central spine 40. However, as shown in Figures 1 and 2, the spring wire 38 is carried by a stop plate 54 that is disposed beneath the arms and engages the arms to force them to assume an orientation that is closer to the plane of the spine. This pre-loads the arms 50 to provide a bias urging the arms to pivot downwardly from the plane of the central spine 40.

The stop plate in turn is rigidly fixed to a relatively heavy and rigid support wire 56. The support wire 56, with a diameter of 0.050 inches, is over twice the diameter of the spring wire 38. The ends 58, 60 of the support wire are fixed as rigidly as possible to the base plate 12 (Figure 1) so as to minimize as much as possible the flexure of the support wire.

As best seen in Figures 2, 3 and 6, each bumper 36 is generally oval in shape. The ends of the oval shape are each provided with a groove 62. These grooves receive the end 52 of the U-shaped arms for attaching the bumpers to the spring wire 38.

The damping system 34 is further shown in Figures 3, 4 and 5 to include components carried by the drive arm 24, which interact with the bumpers 36 and the spring wire 38. These components include a beam 64 that is fixed to a surface of the flat drive arm adjacent its end 26. The beam is generally triangular in cross section and the two upstanding sides or legs of the triangular beam extend upwardly from the drive arm and into the space between the downwardly bent ends 52 of the spring wire. Fixed to and extending outward from each of the upstanding legs is a damper 68. One of the dampers is an inner damper 68A and the other is an outer damper 68B. Each damper is generally triangular in cross section and is fixed to the beam such that a longitudinally extending corner 70 of each damper is disposed to contact one of the bumpers 36 (Figures 5 and 6).

In a start position with the shutter closed, the corner 70 of the inner damper 68A is in contact with the inner bumper 36A (Figures 4 and 6). To operate the shutter, the electromagnet 18 is energized and the armature 20, operating through the rocker arm 22, pivots the drive arm 24 so its end 26 is swung upwardly as viewed in Figure 1. This pulls the connecting link 28 and rotates a driver plate (not shown) to open the shutter. Pivoting the drive arm carries the outer damper 68B forward and into contact with the outer bumper 36B wherein the engagement of one against the other arrests the motion of the drive arm. When the electromagnet is de-energized, a spring 72 returns the drive arm back to the start position to close the shutter. The return motion of the drive arm then is arrested by the engagement of the inner damper 68A against the inner bumper 36A.

In a shutter having an aperture of 45 mm the operating speed of the shutter can be up to 5 Hertz and the speed increases as the aperture size decreases. Operating speeds of up to 400 hertz or more are possible in shutters having an aperture of 2 mm. Accordingly, it is important to arrest the forward and reverse motion of the drive arm quickly, smoothly and with little or no bounce. Several aspects contribute to the successful operation of the damping system of the present invention. For example, one of the damper and bumper is formed of a highly damped polyurethane thermosetting resin that provides high performance damping, isolation, and shock and motion control

with a loss factor in excess of 1.0. A preferred material is a urethane solid having the following properties:

Normal Hardness (ASTM D2240) Shore A Durometer Impact at 73°F (23°C) of about 58,

Glass transition temperature (ASTM D575) of about 18°F (-8°C),

Maximum loss factor at 10Hz and 54°F (12°C) of about 0.94,

Rebound (ASTM D2632) Bashore Resilience

Rebound, 1st impact @ 20°C of about 4.5%

Rebound, 2^{nd} impact @ 20°C of about 0.0%,

Compression Load Deflection (ASTM D575)

10% Deflection about 82 psi (565kPa)

20% Deflection about 180psi (1241kPa)

30% Deflection about 305psi (2103kPa)

Compression Modulus about 845psi (5826kPa).

A suitable material is ISOLOSS ® HD made by Aearo Company.

The other of the damper and bumper is formed of an ultra high molecular weight polyethylene (UHMWPE) having a molecular weight in the range of 3 to 6 million. Such a material typically has a density of at least 0.930g/cm^3 and up to 0.965 g/cm^3. Surprisingly, such a high molecular weight polyethylene provides effective damping when used together with the polyurethane despite the hardness of the polyethylene, which is considered a detriment to effective damping.

In a preferred arrangement the bumper is made of the UHMWPE whereas the damper is formed of the polyurethane. The polyethylene is extrudable to a desired shape of the bumper, as described hereinbelow, whereas the urethane material is not extrudable and must be molded to shape. Also, the urethane is readily attachable to the beam with an adhesive whereas an adhesive attachment of the polyethylene to the beam does not hold up over time and under the stress of repeated impacts.

The present invention also has the components of the damping system arranged to provide substantially point contact between bumper 36 and the damper 70 during the

entire time interval of contact between the two. This is accomplished by providing the bumper with an oval shape as shown and the damper with a longitudinally extending corner 70. The arrangement of the straight corner 70 of the damper striking against the curved surface of the oval bumper (Figure 6) maintains substantially point contact for the duration of the contact time. Limiting the engagement to substantially point contact improves the efficiency of the damping system.

A further contribution to the impact absorbing characteristics of the damping system results from the loading of the arms 50. As described above, the arms are loaded so they are biased in a downward direction. Accordingly an impact of a damper 68 against a bumper 36 that tends to rotate the arm 50 upwardly about the central spine is resisted by the downward bias of the arm. Furthermore, as shown in Figure 5, each end 52 of the U-shaped arm 50 is bent downward at an angle of about 77° or within about 13° of a line perpendicular to the plane of the arm 50. This allows the impact of the damper to be partly absorbed by both an upward flexing in unison of the arm 50 and of the bifurcate central spine 40 of the spring wire. The angle is maintained to insure that the corner 70 of the damper strikes the approximate center of the bumper 36A so the two do not disengage as the bumper deflects upwardly against the resistance offered by the urging of the downward bias of the arm. The angle also prevents the adhesion of the two materials during the contact compression phase when the beam is moved causing the damper corner to impact the bumper.

While all the components as described cooperate to provide an effective damping system, it was found that forming the damper and bumper of polyurethane and high molecular weight polyethylene respectively contributed significantly to the effectiveness of the damper. In particular, these materials served to increase the operational life of the shutter by six times from one to six million operations while virtually eliminating the adhesion of the damper and bumper materials without the use of either anti-stick materials such as Teflon or lubricants.

Having described the invention in detail, what is claimed as new is:

CLAIM OR CLAIMS

1. A damping system for arresting the motion of a body of small mass such as a photographic shutter or the like comprising:

a) a drive arm supported to swing through an arcuate path of travel;

b) a detent having opposite ends disposed to arrest the swinging movement of the drive arm at each end of the arcuate path of travel;

c) shaped bumpers on each of the opposite ends of the detent, the bumpers being composed of a polyethylene having a molecular weight of 3 to 6 million; and

d) a damper on the drive arm engageable with each of the shaped bumpers, the dampers being composed of a polyurethane material.

2. A damping system as in Claim 1 wherein the bumpers and the damper are shaped to provide substantially point contact therebetween during the duration of the engagement as the swinging of the drive arm through its arcuate path of travel carries the damper into engagement with the bumper.

3. A damping system as in Claim 2 wherein the point contact is provided by one of the damper and bumpers having a contact portion that is a straight edge and the other a contact portion that is a curved surface.

4. A damping system as in Claim 1 wherein the detent comprises:

a) a spring wire formed with a central spine and two arms extending outward in opposite directions from the spine;

b) each arm having an outward extending end bent downwardly from the plane of the arm, the two downwardly bent ends defining a space therebetween; and

c) one of the shaped bumpers being attached to each of the downwardly bent ends.

5. A damping system as in Claim 4 wherein the central spine is pivotally supported by a support wire having fixed ends.

6. A damping system as in Claim 4 wherein:

a) the drive arm is a flat member having a beam upstanding from a surface of the drive arm and into the space between the two downwardly bent ends of the arms, the beam having opposite sides; and

b) a damper fixed to each of the opposite sides of the beam.

7. A damping system as in Claim 6 wherein each damper is generally triangular in cross section and is fixed a side of the beam so as to present a straight corner for impacting the bumper.

8. A damping system as in Claim 7 wherein each bumper has a curved surface to receive the impact of the straight corner of the damper thereby providing substantially a point contact of impact between the two.

9. A damping system as in Claim 7 wherein the beam is generally triangular in cross section.

10. A damping system as in Claim 4 wherein the end of each arm is bent downward at an angle of about 77 degrees from the plane of the arm.

11. A damping system as in Claim 1 wherein the dampers comprise a polyurethane material having an ASTM D2240 Shore A Durometer Impact at 73°F (23°C) of about 58, an ASTM D575 glass transition temperature of about 18°F (-8°C), s second ASTM D2632 rebound at 20°C of 0.0, and a Compression Modulus about 845psi (5826kPa).

12. A damping system for arresting the motion of a body of small mass such as a photographic shutter comprising:

a) a drive arm supported to swing through an arcuate path of travel, the drive arm having one pivotally linked to a photographic shutter operated ring;

b) a beam fixed to a surface of the drive arm, the beam having opposite upstanding sides;

c) a damper fixed to each of the opposite sides of the beam, each damper being composed of a damped polyurethane having an ASTM D2240 Shore A Durometer hardness of about 58;

d) an elongated detent support, the support being fixed at its opposite ends;

e) a detent having a central spine and outward extending arms, each arm having an outward extending end that is bent downwardly with respect to the plane of the arm and the spine being pivotally supported by the detent support;

f) a bumper on each of the downwardly bent ends of the outwardly extending arms, each bumper comprising a polyethylene having a molecular weight of 3 to 6 million, each bumper being disposed to receive the impact of a detent thereagainst as the drive arm is swung through its arcuate path of travel; and

g) the damper and bumper being configured to provide a substantially point contact therebetween during the duration of the impact of the damper against the bumper.

13. A damping system as in Claim 12 wherein the damper has a substantially straight corner that impacts against the bumper and the bumper has a curved surface to receive the impact of the damper thereagainst.

14. A damping system as in Claim 13 wherein each outward extending end of each arm is bent downwardly at an angle of about 77 degrees with respect to the plane of the arm.

15. A rotary photographic shutter or the like including a plurality of shutter blades movable between an open and a closed position, a drive means including an actuator for moving the shutter blades between the open and closed positions and a damping system operable to arrest the movement of the drive means at one of the open and closed positions.

16. A rotary photographic shutter comprising:

a) a base plate having a central aperture;

b) a plurality of rotating ring operable shutter blades supported by the base plate for opening and closing the aperture; and

c) a damping system on the base plate operable to dampen the opening and closing of the rotating ring operable shutter blades.

17. A rotary photographic shutter as in Claim 16 comprising:

a) a drive arm pivotally supported on the base plate to swing back and forth through a defined arc, the swing of the drive arm in one direction acting to move the shutter blades to an open position and the swing in a return direction acting to move the shutter blades to a closed position; and

b) the damping system arranged to arrest the swing of the drive arm at each end of the arc.

18. A rotary photographic shutter as in Claim 16 wherein the damping system comprises:

a) a drive arm pivotally supported on the base plate to swing back and forth through a defined arc, the swing of the drive arm in one direction acting to move the shutter blades to an open position and the swing in a return direction acting to move the shutter blades to a closed position;

b) a detent having opposite ends disposed to arrest the swinging movement of a shutter blade operating drive arm at each end of the swing;

c) bumpers on each of the opposite ends of the detent; and

d) at least one damper on the drive arm positioned to strike and engage against each of the shaped bumpers at the limits of the swing of the drive arm.

19. A rotary photographic shutter as in Claim 18 wherein the bumpers and the damper are shaped to provide substantially point contact therebetween during the duration of the engagement.

20. A rotary photographic shutter as in Claim 17 wherein the damping system includes:

a) bumpers carried by one of the driving arm and base plate composed of a polyethylene having a molecular weight of 3 to 6 million; and

b) a damper on the other of the drive arm and base plate composed of a polyurethane material that under goes a transformation from a glass phase to a rubber phase when it strikes the bumpers.

21. A damping system for arresting motion of a body moving through a path of travel comprising:

a) a bumper located at an end of the path of travel;

b) a damper carried by the body and positioned to strike the bumper at the end of the path of travel, the damper comprising a material that undergoes a transformation from a glass phase to a rubber phase when struck thereby causing a tendency of the damper to stick to the bumper; and

c) the damper and bumper having shapes that limit the area of contact between the damper and bumper.

22. A damping system as in Claim 20 wherein the shape of the damper and bumper limit the contact therebetween to substantially a point contact.

23. A damping system for arresting motion of a body moving through a path of travel comprising:

a) a bumper located at an end of the path of travel, the bumper composed of a polyethylene having a molecular weight of 3 to 6 million; and

b) a damper carried by the body and engageable against the bumper, the damper composed of a polyurethane material.

24. A damping system as in Claim 23 wherein the polyurethane material undergoes a transformation from a glass phase to a rubber phase when struck thereby causing a tendency of the damper to stick to the bumper and the damper and bumper having shapes that limit the contact area of one against the other.

25. A damping system for arresting motion of a body moving through a path of travel as in Claim 23 wherein the damper comprises a damped polyurethane having an ASTM D2240 Shore A Durometer hardness of about 58.

26. A damping system for arresting motion of a body moving through a path of travel as in Claim 23 wherein the damper comprises a polyurethane having an ASTM D2240 Shore A Durometer Impact at 73°F (23°C) of about 58, an ASTM D575 glass transition temperature of about 18°F (-8°C), a second ASTM D2632 rebound at 20°C of 0.0, and a Compression Modulus about 845psi (5826kPa).

27. A damping system for arresting motion of a body moving through a path of travel as in Claim 23 wherein the bumpers and damper are shaped to provide substantially point contact therebetween during the duration of the engagement.

28. A damping system for arresting motion of a body moving through a path of travel as in Claim 23 wherein the damper has a cross section providing a straight corner edge arranged to strike the bumper.

29. A damping system for arresting motion of a body moving through a path of travel as in Claim 28 wherein the bumper has a curved surface to receive the strike of

the damper straight corner edge thereby providing the substantially point contact therebetween.

30. A damping system for arresting motion of a body moving through a path of travel as in Claim 23 wherein the moving body is a component of a rotary photographic shutter.

31. A damping system for arresting the motion of a body moving through a path of travel comprising:

a) a damper carried by the body, the damper having a cross sectional shape providing a straight corner edge;

b) a spring mounted bumper located at an end of the path of travel, the spring urging the bumper towards the plane of the path of travel;

c) the bumper having a curved surface to receive a strike of the damper straight corner edge as the body moves to the end of its path of travel thereby providing substantially point contact between the damper and the bumper, and the bumper being positioned so as to receive the strike at a generally central location on the bumper between its opposite ends; and

d) the spring providing sufficient bias to prevent the force of the strike from moving the bumper so far in a direction normal to the plane of the path of travel that the damper passes over one or another of the opposite ends.

32. A damping system as in Claim 31 wherein:

a) the damper comprises a material that undergoes a transformation from a glass phase to a rubber phase when struck thereby causing a tendency of the damper to stick to the bumper; and

b) the damper and bumper having shapes that limit the contact area between the damper and bumper.

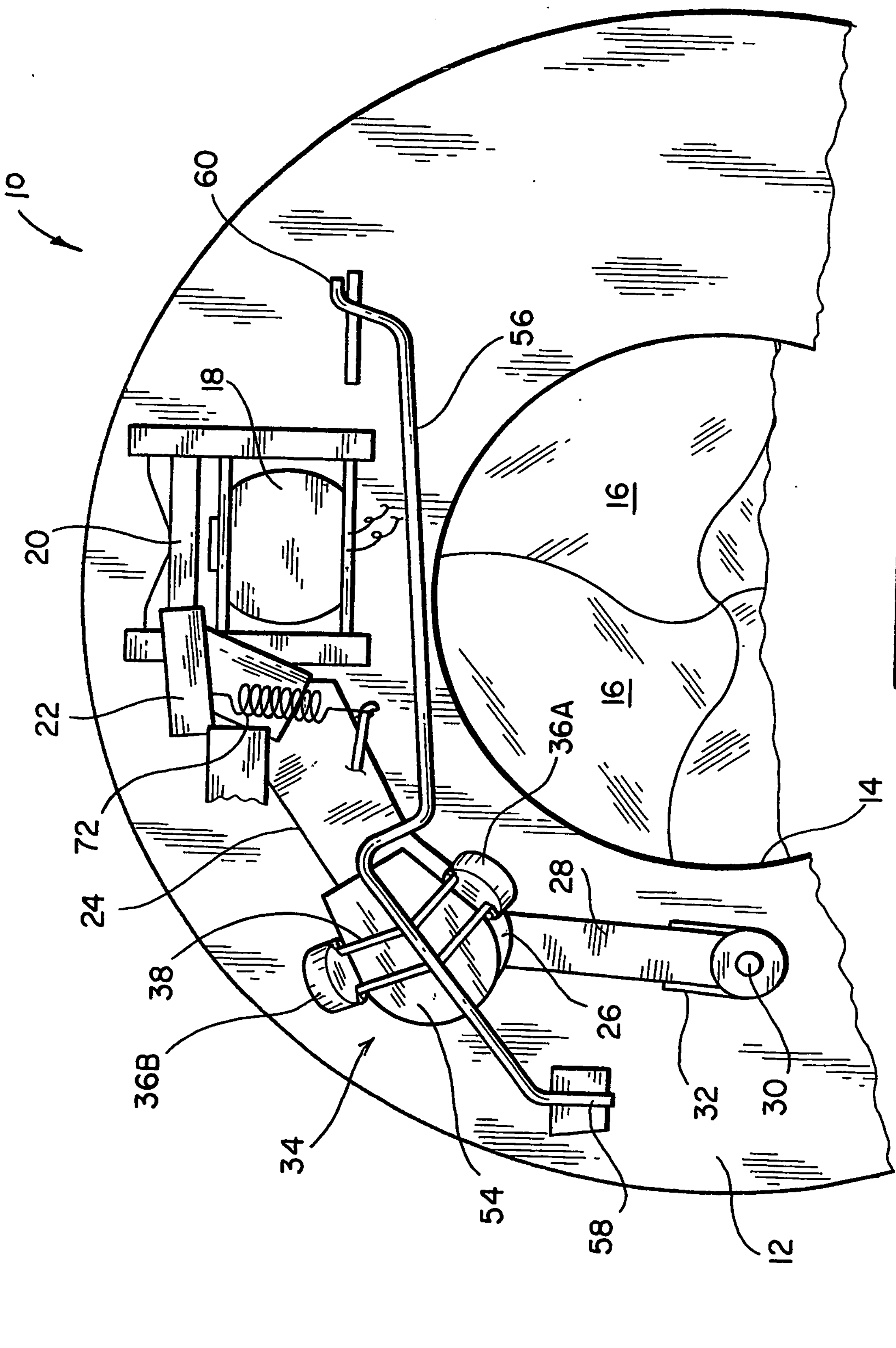
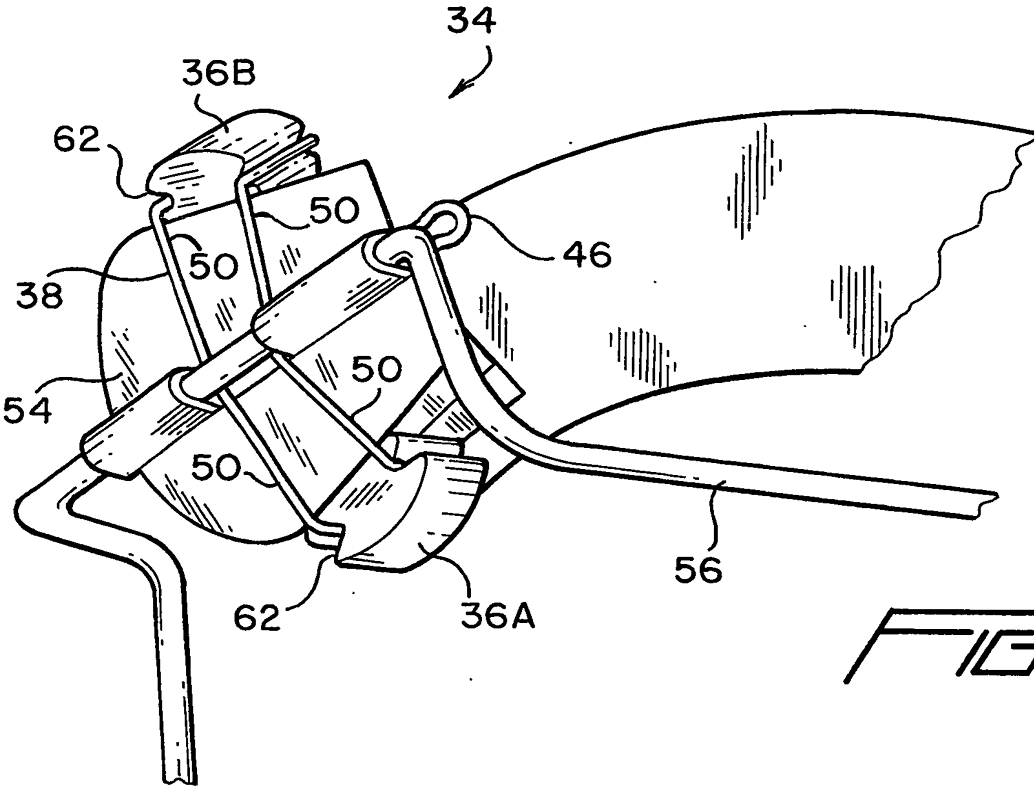


FIG. 1


34
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62
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50
38
46
54
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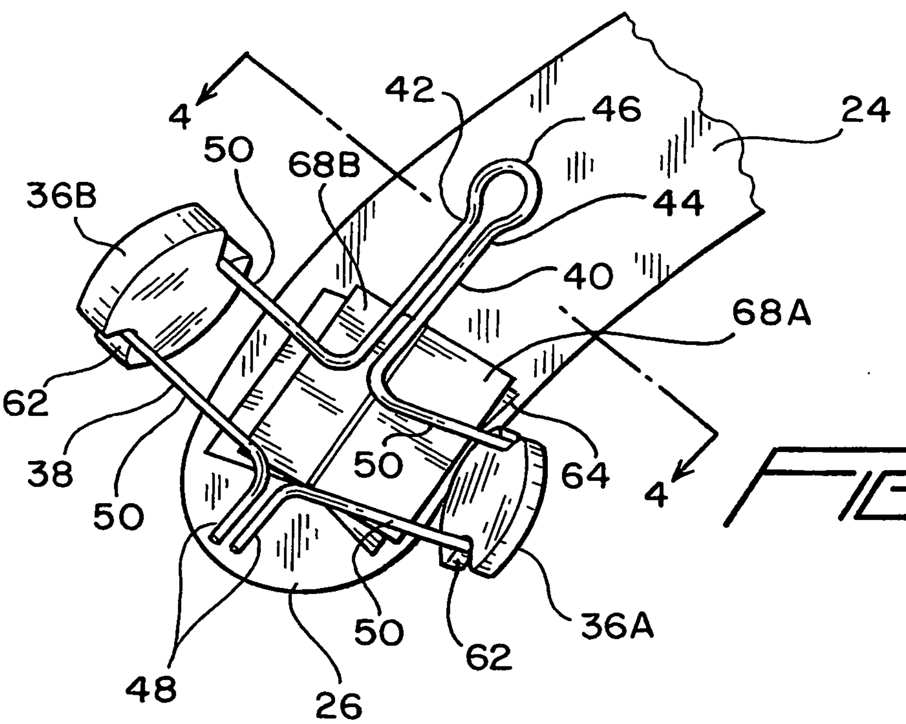
62
36A

FIG. 2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36A
26

FIG. 3

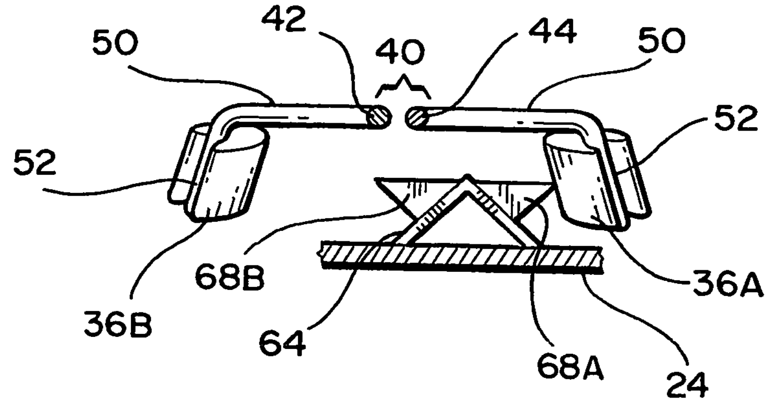

FIG. 4

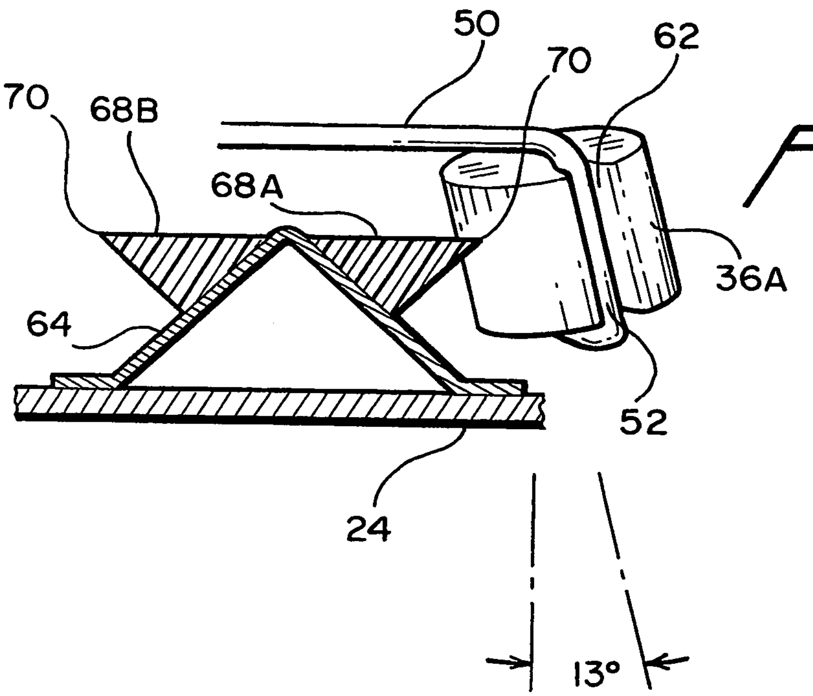

FIG. 5

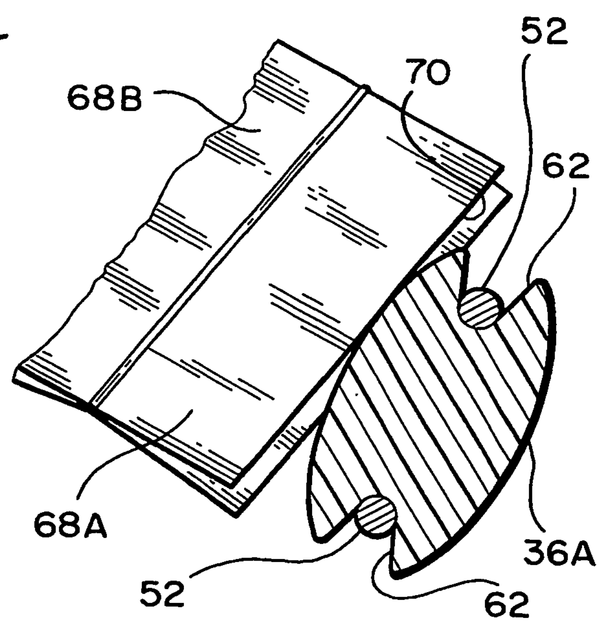

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US03/22287

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) : G03B 09/08
US CL : 396/453
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 396/453-456

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3,967,293 A (VINCENT) 29 JUNE 1976 (29.06.1976)	1-32

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Date of the actual completion of the international search
05 September 2003 (05.09.2003)

Date of mailing of the international search report
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